Antifungal drug

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An **antifungal drug** is a medication used to treat fungal infections such as athlete's foot, ringworm, candidiasis (thrush), serious systemic infections such as cryptococcal meningitis, and others. Such drugs are usually obtained by a doctor's prescription or purchased over-the-counter.

Contents

Mode of action

Antifungals work by exploiting differences between mammalian and fungal cells to kill the fungal organism without dangerous effects on the host. Unlike bacteria, both fungi and humans are eukaryotes. Thus fungal and human cells are similar at the molecular level. This makes it more difficult to find or design drugs that target fungi without affecting human cells. Consequently, many antifungal drugs cause side-effects. Some of these side-effects can be life-threatening if the drugs are not used properly.

Precaution

Apart from side-effects like liver-damage or affecting estrogen levels , many medicines can cause allergic reactions in people. For example, the azole group of drugs is known to have caused anaphylaxis. There are also known contradictions between medicines. Patients must read in details the enclosed data sheet(s) of the medicine.

Classes

Polyene antifungals

Main article: Polyene antimycotic

A polyene is a molecule with multiple conjugated double bonds. A polyene antifungal is a macrocyclic polyene with a heavily hydroxylated region on the ring opposite the conjugated system. This makes polyene antifungals amphiphilic. The polyene antimycotics bind with sterols in the fungal cell membrane, principally ergosterol. This changes the transition temperature (Tg) of the cell membrane, thereby placing the membrane in a less fluid, more crystalline state.

As a result, the cell's contents leak and the cell dies. Animal cells contain cholesterol instead of ergosterol and so they are much less susceptible. As a polyene's hydrophobic chain is shortened, its sterol binding activity is increased. Therefore, further reduction of the hydrophobic chain may result in it binding to cholesterol, making it toxic to animals.

- Natamycin – 33 Carbons, binds well to ergosterol
- Rimocidin
- Filipin – 35 Carbons, binds to cholesterol (toxic)
- Nystatin
- Amphotericin B
- Candicin
- Hamycin

Imidazole, triazole, and thiazole antifungals

The imidazole and triazole drugs are synthetic antifungal drugs that inhibit the enzyme cytochrome P450 14α-demethylase. This enzyme converts lanosterol to ergosterol, and is required in fungal cell membrane synthesis. These drugs also block steroid synthesis in humans.

Imidazoles

- Miconazole – miconazole nitrate
- Ketoconazole
- Clotrimazole – marketed as Lotrimin or Lotrimin AF (and Canesten in the UK)
- Econazole
- Bifonazole
- Butoconazole
- Fenticonazole
- Isoconazole
- Oxiconazole
- Sertaconazole – marketed as Ertaczo in North America
- Sulconazole
- Tioconazole
- Griseofulvin - marketed as india

The triazoles are newer, less toxic and more effective:

Triazoles

- Fluconazole
- Itraconazole
- Isavuconazole
- Ravuconazole
- Posaconazole
- Voriconazole
- Terconazole

Thiazoles

- Abafungin

Allylamines

Allylamines inhibit squalene epoxidase, another enzyme required for ergosterol synthesis:

- Terbinafine – marketed as "Lamisil" in North America, Australia, the UK, Germany and the Netherlands

- Amorolfine
- Naftifine – marketed as "Naftin" in North America
- Butenafine – marketed as Lotrimin Ultra

Echinocandins

Echinocandins inhibit the synthesis of glucan in the cell wall, probably via the enzyme 1,3-β glucan synthase:

- Anidulafungin
- Caspofungin
- Micafungin

Others

- Benzoic acid – has antifugal properties but must be combined with a keratolytic agent such as in Whitfield's Ointment[1]

- Ciclopirox – (ciclopirox olamine), most useful against *Tinea versicolour* [2]
- Tolnaftate – marketed as Tinactin, Desenex, Aftate, or other names
- Undecylenic acid – an unsaturated fatty acid derived from natural castor oil; fungistatic as well as anti-bacterial and anti-viral
- Flucytosine or 5-fluorocytosine – an antimetabolite
- Griseofulvin – binds to polymerized microtubules and inhibits fungal mitosis

- Haloprogin – discontinued due to the emergence of more modern antifungals with fewer side effects [3]
- Sodium bicarbonate ($NaHCO_3$) [4][5] – shown effective against green mold on citrus under refrigeration and powdery mildew on rose plants

Alternatives[6]

- Allicin – created from crushing garlic
- Tea tree oil – ISO 4730 ("Oil of Melaleuca, Terpinen-4-ol type")
- Citronella oil - obtained from the leaves and stems of different species of Cymbopogon (Lemon grass)
- Iodine – Lugols Solution
- olive leaf
- orange oil
- palmarosa oil
- patchouli
- lemon myrtle
- Neem Seed Oil
- Coconut Oil – medium chain triglycerides in the oil have antifungal activities
- Zinc – in dietary supplements or natural food sources, including pumpkin seeds and chick peas
- Selenium – in dietary supplements or natural food sources, particularly Brazil nuts

Anti-dandruff shampoos

Antifungal drugs (such as ketoconazole) are often found in anti-dandruff shampoos. The antifungal drugs inhibit the yeast *Malassezia globosa* which encourages seborrhoeic dermatitis and tinea versicolor.

Active ingredient	Example of product	Comments
Ketoconazole[7]	Nizoral, or Fungoral	There is a claim that Nizoral shampoo has hair loss benefits but Nizoral Shampoo does not have FDA

		approval as a hair loss remedy.[8]
Ciclopirox olamine	Loprox	Has similar efficacy to ketoconazole with a relative increase in subjective symptom relief due to its inherent anti-inflammatory properties[9].
Piroctone olamine (Octopirox)[10]	Nivea Complete Control[11]	A replacement for the commonly used compound zinc pyrithione.
Zinc pyrithione[12]	Head & Shoulders, Johnson and Johnson ZP-11, Clinic All Clear, Pantene Pro V, Sikkai Powder	An antifungal and antibacterial agent first reported in the 1930s.
Selenium sulfide	Selsun Blue, Vichy Dercos Anti-Dandruff shampoo, other varieties of Head & Shoulders	In the United States, 1% strength is available over-the-counter, and a 2.5% strength is also available with a prescription.
Tar[13]	Neutrogena T-Gel	
Tea tree oil[14]	Dr. Bronner's Castile Soap	

See also

- Fungicide
- Antimicrobial

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External links

- **Antifungal Drugs** (http://www.fungalguide.ca/treatments/antifungal_drugs.html) - Detailed information on antifungals from the Fungal Guide written by Drs. R. Thomas and K. Barber